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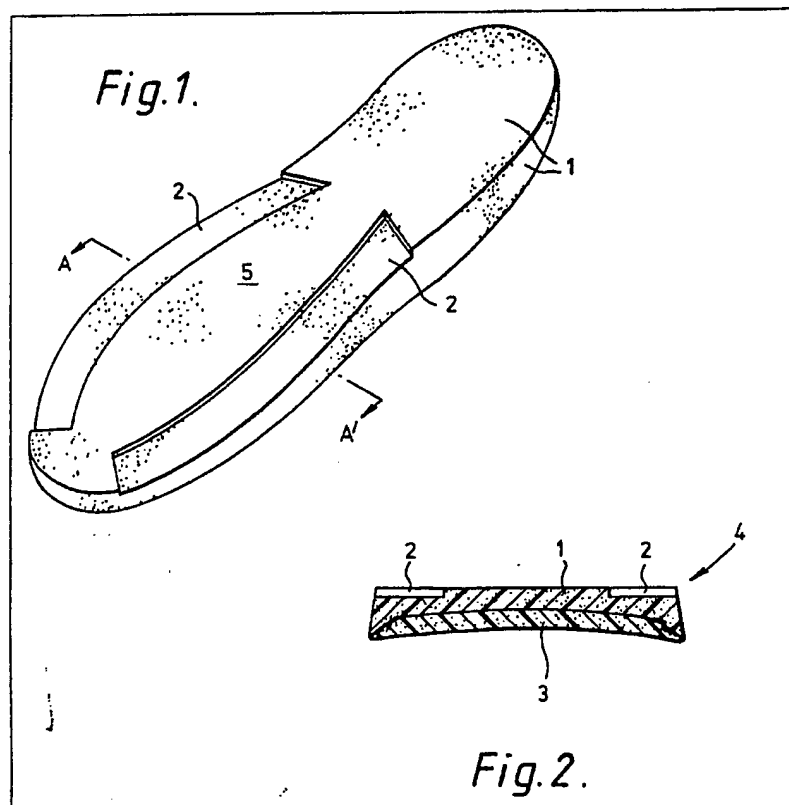
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(54) Laminates and their use as  
shoe soles

(57) A bonded laminate of two layers of closed-cell, foamed, cross-linked polyolefins of different bulk density, in which the layer of higher bulk density 1 is cup-shaped in cross-section such that its edges surround the edges of the layer of lower bulk density 3 and in which the laminate is increasingly consolidated at at least one edge 4. Such a laminate can be used as the sole of an article of foot-wear, the layer of lower bulk density forming the upper layer of the sole.



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Fig.1.

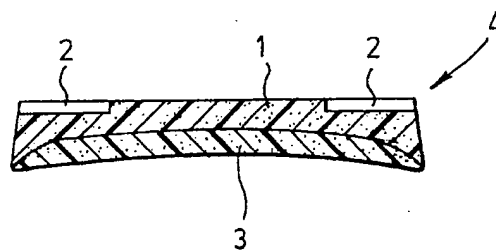
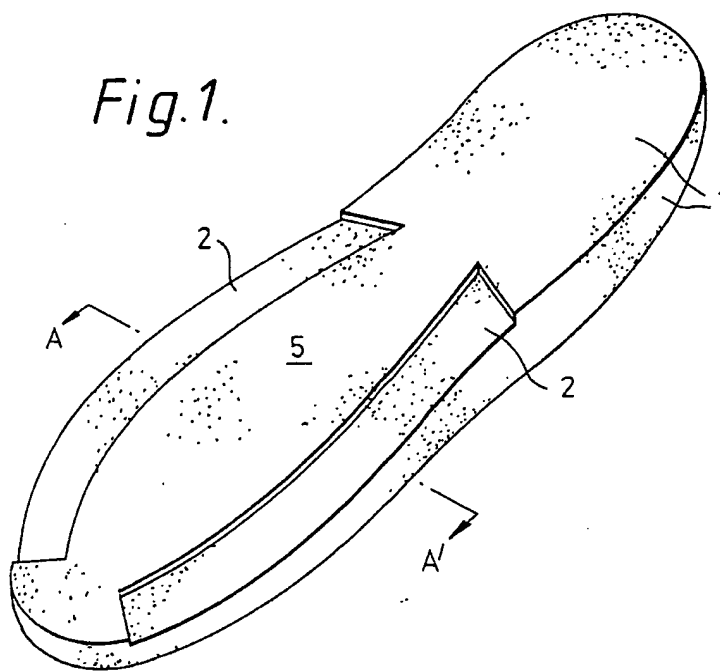


Fig.2.

## SPECIFICATION

## Laminates and their use as shoe soles

5 German Gebrauchsmuster 76 27 371 describes a shoe sole comprising a bonded laminate of two layers of closed-cell, foamed, cross-linked polyolefins of different bulk density. The edges of this laminate exhibit varying elasticity, making it difficult to secure a covering material thereto. Under the bending stress which occurs in use, a non-uniform, unsightly crease formation is observed.

10 According to the present invention, a bonded laminate comprises two layers of closed-cell, foamed, cross-linked polyolefins of different bulk density, in which the layer of higher bulk density is cup-shaped in cross-section such that its edges surround the edges of the layer of lower bulk density, and in which the laminate is increasingly consolidated at at least one edge thereof. Such a laminate can be used as a sole of an article of footwear, in which case the layer of lower bulk density forms the upper surface and the layer of higher bulk density forms the lower and side faces.

15 It is preferred that, while the thickness at the edge of the layer of lower bulk density may decrease to zero, the difference in thicknesses of the two layers at the centre of the laminate, in cross-section, is no more than 30%. The preferred polyolefin for use in both layers of a laminate according to the invention is polyethylene. The polyolefin is preferably cross-linked to a degree of at least 50%.

20 A laminate of the invention may be prepared by first laminating two layers of suitable material, preferably by flame-lamination. The material of the layers may have been foamed freely or in moulds or divided from larger blocks. The laminated product may then be deformed, suitably by heating at a temperature which is usually about 130°C. The product is then finished by vacuum-forming or press-forming. The forming tool should be so constructed that the foam structure is increasingly consolidated, i.e. collapsed, outwardly along one edge margin around the edge of the laminate which is to form the upper edge of the sole, when used as such. The greatest specific density is in the area of this zone; with increasing pore diameter in the centre of the laminate, the specific density decreases substantially evenly to the normal value, i.e. the value in the absence of consolidation. The most consolidated edge zone may be substantially pore-free.

25 It will be appreciated that the layer of lower bulk-density need form only one face of the laminate. In use of the laminate as a sole in an article of footwear, the areas which are normally covered with a covering material, uniform in itself, have a homogeneous construction.

It is preferred that the bulk density of the layer of higher bulk density should be at least twice as large as that of the layer of lower bulk density. The higher bulk density value is preferably at least 150 kg/m<sup>3</sup> and more preferably at least 175 kg/m<sup>3</sup>, e.g. from 175 to 180 kg/m<sup>3</sup>. The layer of higher bulk density may be from 2.5 to 5.5 mm thick.

30 In use of a laminate of the invention as the sole of an article of footwear, the lower of the two layers, that of higher bulk density, assumes all essentially static functions. A sandal strap can be satisfactorily attached thereto.

35 The cup-shaped construction allows a lower wall thickness than for comparable prior art constructions. The upper layer, that of lower bulk density, is more conformable to the human foot than the upper face of conventional two-layer laminate soles. After a short wearing time, a laminate sole of the invention assumes substantially the particular anatomical characteristics of the wearer and this can reduce or eliminate pumping or breathing movements of the sole, and premature symptoms of tiredness are minimised.

40 The invention will now be illustrated by way of example with reference to the accompanying drawings. The two Figures show one embodiment of the invention, respectively in perspective view from below and in cross-sectional view along the line A-A' of Fig. 1.

45 All visible areas of the laminate of Fig. 1 are formed by the lower foam material layer 1 which has a higher bulk density than the upper foam material layer 3. In its forward part, the foam material layer 1 has openings 2 which can serve to secure a sandal strap. The non-cut-away section 5, between the cut-away portions 2, provides a static reinforcement additional to that of the edges of the laminate.

50 Fig. 2 shows that the lower foam material layer 1 is highly drawn, vertically, along its edge, so that it exhibits a cup-shaped profile in which the upper foam material layer 3 is embedded. The foam structure of both layers is outwardly increasingly consolidated along one peripheral edge portion at the upper edge of the sole, providing a pore-free structure in the outermost region 4. There is an even diminution in pore size, the interior of the layer having a suitable cell pore size and also a suitable bulk density.

## 120 CLAIMS

1. A bonded laminate of two layers of closed-cell, foamed, cross-linked polyolefins of different bulk density, in which the layer of higher bulk density is cup-shaped in cross-section such that its edges surround the edges of the layer of lower bulk density, and in which the laminate is increasingly consolidated at at least one edge thereof.

2. A laminate according to claim 1 in which the most consolidated edge is substantially

tially pore-free.

3. A laminate according to claim 1 or claim 2 in which the higher bulk density is at least twice as great as the lower bulk density.

5 4. A laminate according to any preceding claim in which the higher bulk density is at least 150 kg/m<sup>3</sup>.

10 5. A laminate according to claim 4 in which the higher bulk density is from 175 to 180 kg/m<sup>3</sup>.

6. A laminate according to any preceding claim in which, substantially at the cross-sectional centre thereof, the difference in thickness of the layer is no more than 30%.

15 7. A laminate according to claim 1 substantially as illustrated in the accompanying drawings.

20 8. An article of footwear of which the sole comprises a laminate according to any preceding claim, in which the layer of lower bulk density is the upper layer.

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